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Professional paper

EVALUATION OF THE RELATIONSHIP OF CURVE OF SPEE WITH DENTOSKELETAL MORPHOLOGY IN SAGITTAL MALOCCLUSIONS

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Abstract

Curve of Spee is defined as the line on a cylinder which is tangent to incisal edges of lower anteriors, occlusal surface of lower second molar and anterior border of condyle. The aim of the study is to determine whether there is a relationship between curve of Spee and craniofacial morphology in different sagittal malocclusions and to determine the influence of craniofacial morphological features in different sagittal malocclusions on curve of Spee. The research consists in the analysis of lateral cephalograms and study models of 90 patients, age 15-25 years which includes skeletal class I, class II and skeletal class III. Patients are divided into three groups: group A-flat curve of Spee i.e. < 2mm, group B - normal curve of Spee i.e. 2-3 mm, and group C - deep curve of Spee i.e. >3mm. In the literature, there is little data on research that has been done on this topic, on the other hand, in our daily work as orthodontists, we encounter the problem of leveling the deep bite.

Keywords: Curve of Spee (CoS), sagittal malocclusions, lateral cephalograms, orthodontic study models.

1. Introduction

Curve of Spee is defined as the line on a cylinder which is tangent to incisal edges of lower anteriors, occlusal surface of lower second molar and anterior border of condyle (Spee FG, 1980).

The curve of Spee is a naturally occurring phenomenon in the human dentition. This normal occlusal curvature is required for an efficient masticatory system. Graf von Spee was the first to use skulls with abraded teeth to define a line of occlusion, first described the curve of Spee in 1890 (Kumar KP and Tamizharasi S, 2012). Clinically Curve of Spee is measured from distal marginal ridges of the most posterior teeth in the arch to the incisal edges of the anteriors (Marshall et al, 2008). This naturally occurring phenomenon has clinical significance in orthodontics and restorative dentistry. Andrews described the curve of Spee as the sixth key to normal occlusion. He found that the curve of Spee ranges from flat to mild in subjects with proper occlusion and hence best static occlusion can be achieved with flat occlusal plane. The understanding of how the curve of Spee develops is limited in literature. It has been mentioned that an imbalance between the anterior and posterior components of occlusal force can lead to supra eruption of lower incisors, infra eruption of premolars, mesial inclination of lower molars. In case of flat curve of Spee, the pull of masseter muscle, is at perpendicular angle with line of occlusion and long axis of each lower posterior tooth is aligned nearly parallel to their individual arch of closure forming a series of sloped contact points. This geometrical arrangement produces maximum number of tooth contacts and favorable loading providing highest masticatory efficiency. On the other hand, excessive

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curve of Spee alters the muscle balance, leading to the improper functional occlusion by imbalance between the anterior and the posterior components of occlusal force.
The aim of the study is to determine whether there is a relationship between curve of Spee and craniofacial morphology in different sagittal malocclusions and to determine the influence of craniofacial morphological features in different sagittal malocclusions on curve of Spee.

2. Bibliography review

The influence of craniofacial morphology on the curve of Spee (CoS) has been systematically investigated in very few studies and with conflicting findings. (Marshall et al 2008) reported that there are no significant differences in maximum depth of CoS between either the right or left sides of the mandibular arch, or according to gender. In the study of (Veli et al 2015), depth of the CoS was greatest in the Class II division 1 malocclusion group, followed by Class II division 2, Class I, and Class III malocclusion. (Shannon and Nanda 2004) reported that patients with a Class II malocclusion had a significantly deeper CoS than those with a Class I malocclusion. (Kumar and Tamizharasi 2012) reported that the CoS was influenced only to a minor extent by craniofacial morphology. On the other hand, (Farella et al 2002) reported that condylar height (relative to the occlusal plane) and anteroposterior position of the mandible (relative to the cranial base) are associated with CoS depth. (Farella et al 2012) also reported that the CoS was also influenced by the position of the mandible with respect to the anterior cranial base (i.e., SNB angle), regardless of the reciprocal position of the lower and upper jaw in the sagittal plane (ANB angle). (Baydas et al 2004) reported that there were no statistically significant differences in inclinations of the upper and lower incisors and lower anterior crowding between the Spee groups.
More researchers have proposed ways to estimate the space needed for COS leveling, but still there is no consensus on how much space is needed (Barrington W. Dykes 2022). A deep curve of Spee was the highest contributing dental factor confirming the importance of intruding the mandibular incisors or extruding the posteriors in deep overbite mechanotherapy (Joshi 2021). (Araújo Paes-Souza et al 2022) based on evidence, it might be suggested that: (a) dentoskeletal Class II presents a greater depth of COS, while Class III dental malocclusion shows a fatter COS, both compared to Class I; (b) deep bite and the hypodivergent skeletal pattern present a deeper COS compared to normal over bite and normodivergent skeletal pattern, respectively; and (c) subjects with skeletal Class III malocclusion, as well as hyperdivergent individuals do not show significant variations in the depth of COS when compared to skeletal Class I malocclusion and normodivergent individuals.

3. Materials and Methods

The clinical research is performed in the specialized private dental clinic "Finesë dental" in Prizren, under scientific supervision from the Department of Orthodontics at the Faculty of Dentistry at UKIM in Skopje.
The research consists in the analysis of lateral cephalograms and study models of 90 patients, age 15-25 years which includes skeletal class I, class II and skeletal class III.
Patients for the trial have been selected based on certain criteria.
Inclusion criteria:

- Caucasian aged 15-25
- Without craniofacial anomalies, syndromes, hyperdontia and hypodontia of teeth (except third molars);
- No visible facial asymmetry;

- No need for surgical interventions.

Exclusion criteria:

- Previous orthodontic treatment,
- Unilateral or bilateral posterior crossbite,
- Periodontal disease,
- Posterior dental crowding,
- Morphological anomaly of the teeth,
- Dental restoration or crown,
- Mandibular asymmetry,
- Tmj dysfunctions.

According to the depth of curve of Spee, patients are divided into three groups:

- Group A= Flat curve of Spee i.e. < 2mm,
- Group B = Normal curve of Spee i.e. 2-3 mm, and
- Group C = Deep curve of Spee i.e. >3mm.

The cephalometric analysis aims to assess the vertical and sagittal skeletal craniofacial dimensions, as well as the position of the mandibular condyle with respect to the occlusal plane. Measurements and analyzes in cephalometry are performed with a special digital program.

1. *The following skeletal vertical parameters are performed*: NS/SNA-SNP (angle between sella-nasion line and palatal plane), NS/MP (angle between sella-nasion line and mandibular line), SNA-SNP/MP (angle between palatal line and mandibular line), Ar- Go-Me (angle between ramal and mandibular line), S-Go(distance between sella and gonion), N-Me distance between nasion and menton), N-SNA (distance between nasion and anterior nasal spine), SNA-Me (distance between anterior nasal spine and menton), U6-SP(mm) [drawn perpendicularly from the mesiobuccal tip of the lower first molar to the SP plane (SNA-SNP)], L6-MP(mm), [drawn perpendicularly from the mesiobuccal tip of the lower first molar to the mandibular plane (Go-Gn) steiners], OJ(mm) (vertical position of molar point M).
2. *The skeletal horizontal parameters*: SN (distance between sella and nasion), SNA(angle between sella-nasion line and nasion-A line), SNB (angle between sella-nasion line and nasion-B line), ANB (angle between nasion-A line and nasion-B line), Cd-Gn (distance between condyle and gnathion), Cd-A (distance between condyle and point A), OM(mm) (horizontal position of molar point M).
3. *The angular cephalometric parameters*: U1-NA: Upper incisor to NA line (angle formed between the extension of the long axis of the maxillary incisor and the NA line), U1-SN: Upper incisor to SN plane (angle formed between the extension of the long axis of the maxillary incisor and the plane sela-nasion), U1-PP: Upper incisor to palatal plane (angle formed between the extension of the long axis of the maxillary incisor and the palatal plane), L1-NB: Lower incisor to the NB line (angle formed between the extension of the long axis of the mandibular incisor and the NB line), L1-PP: Lower incisor to the palatal plane (angle formed between the extension of the long axis of the mandibular incisor and the palatal plane), L1-OP (Lower incisor to the occlusal plane).
4. *Parameters that determine the position of the mandibular condyles in relation to the occlusal plane according to Osborn*. These are actually parameters that determine the position of the lower teeth in relation to the condyle. Position of the lower dentition in relation to the condyle: Condyle point J (center of the articular surface of the condyle), the molar point M (the most posterior point on the occlusal line of the lower dentition), the incisor point I (the most anterior point on the occlusal line of the lower dentition), point O [intersection between the occlusal line (IM) and the perpendicular to IM

through J]. The horizontal position of M was defined by the distance OM, the vertical position by the distance OJ.

5. *The linear cephalometric parameters:* U1-NA mm, Upper incisor to NA line (the horizontal distance between the labial surface of the maxillary central incisor and the NA line). L1-NB mm, Lower incisor to NB line (the horizontal distance between the labial surface of the mandibular central incisor and the NB line).

Gnathometric analysis are performed on plaster casts of the subjects, obtained by casting anatomical impressions of the upper and lower jaw using an Alignat Heraeus Kulzer elastic mass, and fused to an individual wax bite.

The measurements of all parameters in this study have been performed using a digital caliper-Extol premium, a three-dimensional caliper according to Korkhaus, and an orthodontic measuring instrument - an orthometer with a millimeter division according to Korkhaus.

The following dental parameters have been measured and determined on the plaster study models:

- *Curve of Spee*: The depth of curve of Spee was measured as the perpendicular distance between the deepest buccal cusp tips and a scale that was laid on the top of the mandibular dental cast, touching the incisal edges of the central incisors and the distal cusp tips of the most posterior teeth in the lower arch. The depth of the curve of Spee was measured with a divider placed between the deepest cusp tip and the scale. The measurements were made on the right and left side of the mandibular cast and the mean value of these two measurements was used as the depth of curve of Spee.
- *Overjet*: It is the horizontal distance in millimeters that extends from the labial surface of the mandibular central incisor to the labial surface of the maxillary most prominent incisor.
- *Overbite*: It is the vertical distance in millimeters, representing the total length of the crown of the mandibular incisors overlapping by the maxillary incisors.
- *Lower intermolar width*: Width of the dental arch, determined by measuring the distance between the right and left central pits of the first molars.
- *Lower arch depth*: Normal distance in the midsagittal plane from the most labial midpoints between the central incisors to the line connecting the distal surfaces of the second premolars
- *Molar relations by Angle.*

4. Statistical Processing and Data Analysis

The data obtained during the research will be statistically processed using the SPSS software package, version 22.0 for Windows (SPSS, Chicago, IL, USA).

5. Expected results

Through this study, it will be assessed whether the curve of Spee is affected by the craniofacial morphology of various sagittal malocclusions. The importance of the research is that it will give the right directions for accurate diagnosis, therapy planning, as well as the posttreatment retention protocol for maintaining and evaluating the stability of the treatment results.

6. Application of research results

In the literature, there is little data on research that has been done on this topic, on the other hand, in our daily work as orthodontists, we encounter the problem of leveling the deep bite. The treatment of a deep bite is difficult even for the most experienced orthodontists, of course due to the many post-therapeutic relapses.

Even after treatment and leveling, therefore, it is of particular importance to find the factors that prevent the formation of a deep Spee curve and to stop or reorient the development of the jaws in order to prevent such a process.

Therefore, such research will contribute a lot to the field of orthodontics in general and to our practice.

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